

## Ergotic Sounds

Exploring an audio-haptic feature in a virtual "cello-like" performance



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**Assumption: Instrumental Musical Experience, in its elementary principles, is an emblematic case of Enaction.**

The representation of the instrumental situation can only be the situation itself

*Enactive theory of cognition: the world without representation*

The meaning (musicality for ex.) emerges from the instrumental situation itself

*Cognitive shapes do not pre-exist: they are emerging from the interaction with the environment*

The learning of the performance (the task) and of the musicality (cognitive category) emerging during the performance itself leads to a robust performance know-how.

*Enactive knowledge acquired during the experiment is a robust knowledge.*

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**What is the basic difference between Instrumental Musical Experience and Non - Instrumental Musical Practices?**

In the Instrumental Musical Experience, the performer and the played object are physically dynamically coupled during the playing.

- ERGOTIC Relationship [Cadoz 88]
- Physical effort is an important Musical parameter for both the artist and the audience [Vertegall 96]

The sound produced engraves the physical energy exchanged between the performer and the instrument. There is an « Ergotic Relation to the sound ».

➔ « Ergotic Sounds »

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**Non -Instrumental Musical Practices: A Non-Ergotic relation to the sound**



**Instrumental Musical Practices: An Ergotic relation to the sound**



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### How to catch the role of ergotic relation in musical performance?

We select a difficult feature, estimated in real practices as impossible to do by other ways.

### Maintaining the continuity of the sound \*\*\*

A musical feature

\*\*\* when changing the bow direction

A gestural and mechanical constraint

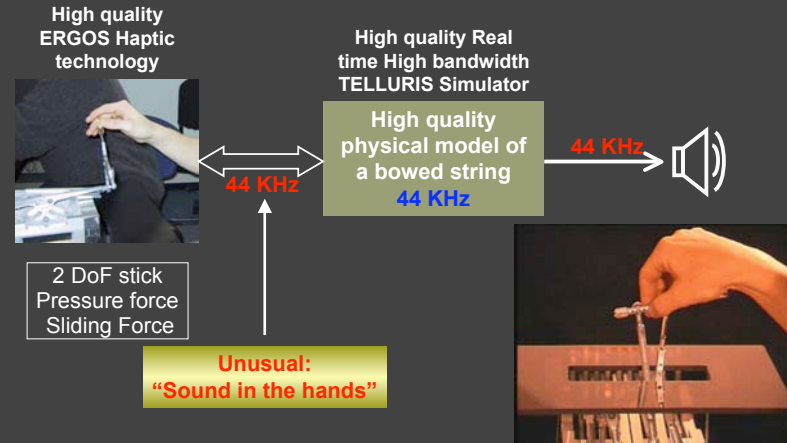
*In real instrument, high level of expertise in that task is obtained with long learning and rehearsal*

This feature is objectively observable on the signals  
It is subjectively identifiable by experts performer and audience

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### Description of the platform



## Experience with the virtual violin Preliminary step

As a preliminary step, participants are invited to explore freely the virtual « cello »

- Without Sound
- With Sound



### Without sound feedback

For most of the people, haptic feeling is not the same with sound.  
*Friction seems rougher. Roughness is dominant.*

For most of the people, haptic feeling is not as in a real instrument.  
*On real playing, they don't put attention on the haptic sensation. They don't know (or imagine) what the haptic sensation is*

Most of the people do not identify a bowed string.  
*People speak freely about zipper, rattle, wheel friction on road ...*

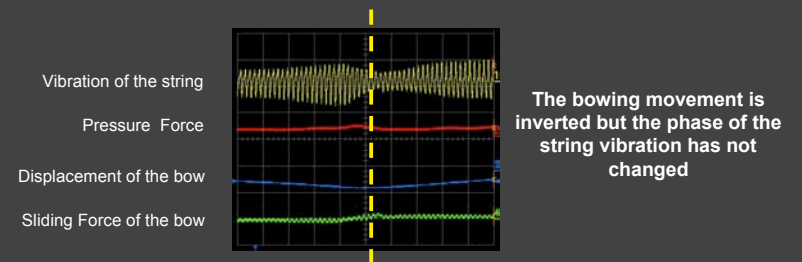
**What is really the friction sensation in a real bowed string?  
Usually, no focus on sensation \*\*\* Sensation is not important**

## "continuous sound with bow direction changing" Experimental protocol

**Performer Subjective Observation**  
Tell when goal is reached. Time Measurements.

**Audience Subjective Observation**  
Tell when goal is reached. Time Measurements.

**Objective observation of signals**  
Vibration of the string, Pressure force, Displacement of the bow, Sliding Force



**Changing the physical parameter that regulates the friction force**  
4 cases: (0) No Friction ; (1) Slight Friction ; (3) Normal friction; (4) Very strong friction

## “Continuous sound with bow direction changing”

### With Slight or Normal Friction

Most of the people reach several times the goal

Even if they estimate they are bad or non expert  
In a short time : no more than 15 minutes  
Occurrence of success : greater than in real case



### With Exaggerated friction

A very few number of people reach the goal

Best scores : blind people  
For all, it is difficult and non satisfying



### With Null friction

A very few number of people reach the goal

Best scores : blind people  
Scores better than with exaggerated friction  
Some people estimate that they can reach with learning

Adequate Well tuned ergotic relation to the sound is important

## “Continuous sound with bow direction changing”

### Richness of modes of playing and dynamic adaptivity

Continuous adaptation of gestures to find the solution

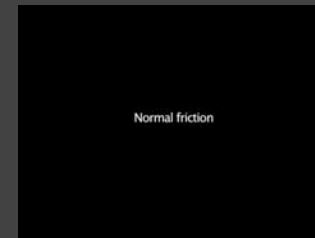
Exploration of various modes of grasping and postures  
With fingers, hand palm, deployed arm, strong full hand grasping, ...

### Wide Exploration of Dynamic strategies

Transforming the bow direction changing in soft round turning

Road turns, Möbius movement, elliptic trajectories, ...  
Modulating the cinematic of the gestures

Acceleration - deceleration on the point of changing  
Relaxing the pressure before or after the turn point, ...

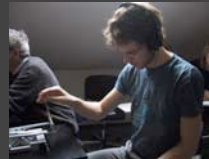


## “Continuous sound with bow direction changing”

### Very Fast Learning (less than 15 minutes)

People improve very quickly the quality of their gestures

Fast exploration of a wide range of dynamic strategies  
A priori imagined strategies not necessary good



People learn on the fly “to be within the situation”

“Relax and let the bow act by itself just before the turn”  
Best : blind people (fine experts in haptic - audio strategies)  
and non predetermined cognitive styles (kind of novices)

### Affordance and Creativity

Exaggerated / Normal Friction

“Exaggerated friction” is non affordant for most people  
However, it stimulates some others to new type of gestures and sound. It stimulates **CREATIVITY**.



“Normal case” is the most playable and pleasant case for all.  
However, ways of playing are more **CONVENTIONAL**.

## “Ergotic Sounds” Conclusion

### Adapted Ergotic Sounds Situation

Enhances instrumental learning and playability

Supported by « on the fly » dynamic adaptation

Supports the success of the goal

When learning is acquired, haptic sensation may be degraded

**ENACTIVE MEMORY**

Enhances the sense of PRESENCE of the string

“Normal Case” : Rich to feel the string in the hand

Strong **Presence of the String**

Sound - Haptic reinforcement

Thanks to the 44Khz  
haptic simulation  
&  
Ergotic Sounds